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Putting Maths Education Back on Top

by Andrew Einhorn

Andrew grew up in Johannesburg, completed a degree in Physics at Harvard, and returned to South Africa in 2007 to work as an investment analyst at Allan Gray. In 2011, he founded Numeric, a non-profit company whose mission is to help young South Africans excel in mathematics and to train high quality maths teachers. Today Numeric runs afterschool programs for children in 45 partners schools across Soweto, Khayelitsha, Mfuleni and Mitchells Plain. They have also launched a small teaching academy that aims to recruit talented young South Africans into the teaching profession and provide them with the training they need to become world-class maths teachers.

Abstract

For every 100 learners who enter the South African schooling system in Grade 1, only 48 will make it to Matric. Of the 48 who make it to Matric, only 22 will take Maths as a subject.

Of the 22 who take Maths, only 10 will pass. And of the 10 who pass, only 4 will pass with a mark greater than 50 per cent. As a result, we are not producing the doctors, scientists, engineers, teachers etc. needed to build South Africa into a thriving and stable civil society.

In this opinion piece, Andrew discusses the roles of teachers and technology in South African maths education, arguing that while technology can be beneficial, the long term solution lies in the recruitment and training of our teachers. He concludes the piece with several policy proposals that he believes would greatly aid our progress toward rebuilding maths education in South Africa.

The proposals include, include: the development of a stronger recruitment strategy for a Bachelor of Education and Post-Graduate Certificate in Education programs; introducing board exams for final year maths teachers in training; and lastly to place a heavy emphasis on the recruitment, and a appropriate remuneration, of quality lecturers in the teacher-training space.

Putting Maths Education Back on Top

by Andrew Einhorn

Working in education, I often find myself in conversations with friends (not in education) who have various theories as to why South African educational outcomes are so poor. Many lament the trade unions, suggesting that their stranglehold on school activities is the primary inhibitor of progress. Others lament the curriculum, calling for curriculum reform across the board. More recently it has become popular to suggest that technology is the solution to our problems, and if our schools "could just get tablets into the hands of their learners" our problems would be solved.

In 2007, McKinsey produced a landmark report on education entitled "How the world's best-performing schools come out on top"[1]. This was an extensive study of fifty education systems across the globe, which attempted to analyse the components of these education systems that made some more effective and others less effective. From the executive summary of that report, they singled out one conclusion from their research that stood out far above the rest. Simply stated, they said, the quality of an education system cannot exceed the quality of its teachers. No matter the curriculum you employ, no matter what the teacher-to-learner ratio is, no matter what infrastructure you build, or technology you install – all of these factors pale in comparison to the importance of the teacher. They conclude by saying: "Of all the controllable factors in an education system, the most important by far is the effectiveness of the classroom teacher. The world's best-performing school systems make great teaching their north star."

Now I have a confession to make. After a brief career as an investment analyst, I entered the world of education, convinced that technology was the solution to our problems. I had watched a wonderful TED talk by the founder of Khan Academy, a powerful online learning platform that provides world-class instructional videos in school mathematics, together with a gamified exercise platform where learners can practice what they have learned in the videos. Not only is the platform gamified to keep it interesting (learners can earn points and badges for meeting certain progress milestones), but the platform is entirely free. Outstripping its commercial counterparts by some margin, I saw an opportunity to use Khan Academy to strengthen township maths education. My vision was to set up hubs in township areas with a view to giving children access to world-class instruction in mathematics.

This all happened in 2011. By the end of 2012, we had seven classrooms of learners in four different locations attending Khan Academy classes every week. The idea was to see if we could combine an average facilitator (usually an unemployed twenty-something-year-old) with Khan Academy to produce above-average outcomes for learners. In short, the formula we were testing was:

Average Facilitator + Khan Academy = Above Average Outcome

1 http://mckinseyonsociety.com/how-the-worlds-best-performing-schools-come-out-on-top

This was a highly attractive prospect. If we could get the formula to work, we could – at relatively low cost – use this model to breathe some life into township maths education.

For those not familiar with the problem, it is most easily summarised as follows: For every 100 learners who enter the South African schooling system in Grade 1, only 48 will make it to Matric. Of the 48 who make it to Matric, only 22 will take Maths as a subject. Of the 22 who take Maths, only 10 will pass. And of the 10 who pass, only four will pass with a mark greater than 50 per cent.[2] If you further consider that of these four, approximately three come from fee-paying ex-Model C and private schools, then just 1 out of every 100 learners in South Africa comes from a lower-income school and passes Maths at the 50 per cent hurdle.

The model we set up was nothing unusual. We installed computer labs at community centres in township areas, installed high-speed internet connections, and invited learners to apply for our programs. Participating learners would attend twice a week for 1½ hour sessions during which they would watch videos, do exercises, and interact with the Khan Academy platform. We used whoever we could find to facilitate: students, unemployed youth, NGO-volunteers, anyone from the community who was reasonably comfortable with technology and not averse to working with twelve and thirteen year-old kids.

By the end of 2012, I had had my first real taste of failure. In spite of working tirelessly to ensure the quality of the labs and the internet connections, we produced a pretty mediocre set of results. Certainly they were not the type of results I could sell to philanthropic foundations who wanted to invest in South African maths education. But in spite of my disappointment (I had abandoned careers in science and finance to pursue this initiative), there was one rather anomalous outcome that gave me hope.

My background in science and my recent priming as an investment analyst had led me to take a highly quantitative approach to these Khan Academy pilots. Among other things, we measured the following key metrics for each classroom of kids:

i. Attendance rate
ii. Persistence rate (percentage of learners who complete the full-year program, i.e. do not drop out)
iii. Number of Khan Academy videos watched and exercises completed
iv. Shift in test scores as measured using externally administered baseline and endline tests.

For six of the seven classrooms, these metrics were lukewarm at best. There was, however, one classroom that exhibited uncharacteristically good results: high persistence rates, high attendance rates, material Khan Academy progress, and strong shifts in test scores as measured by the baseline and endline tests. Curious to see what was driving these results, I began spending more time in this particular classroom. And fairly quickly the answer became apparent. The student we had put in charge of that group of learners was far from average. He was, in

2 In South Africa the pass hurdle for mathematics is set at 30 per cent.

fact, quite exceptional. He had a keen interest in mathematics and had developed a good proficiency in the curriculum himself. He had a particular knack for motivating the learners, encouraging them when they were struggling, and praising them when they made progress. He provided structure, held learners accountable, got to know each learner personally, and took full ownership of the classroom and his outcomes.

In all likelihood I would have abandoned this initiative had it not been for this young coach who showed me that success was not so much about the presence of technology in the classroom as it was about the quality of the person we put in charge. If I had only read that McKinsey report earlier, I might have spared myself a couple of years of hard work and frustration. I guess you have to learn some lessons the hard way.

This discovery was corroborated when Numeric (the non-profit company we had formed to house these pilots) launched programs in Soweto in 2014. We had been assured that the Gauteng Online project had installed computer labs and connectivity in every school, but by the time we had secured the funding and relevant partnerships with schools, we discovered that these labs were simply not viable for a platform like Khan Academy. Rather than abandon the Soweto project, however, we doubled down on our coach recruitment and training efforts. We recruited vigorously from the surrounding universities, primarily students in the Bachelor of Education programs. In the end we received six applications for every coaching position we had available. It was the most competitive recruitment process we had run yet. Furthermore, we doubled up on the training process, increasing it from one week to two full weeks, and extending training hours from the regular 9am–5pm to 8am–6pm. I was nervous about not having Khan Academy to lean on for support, so we just went a little crazy in our recruitment and training to compensate.

The upshot was that in 2014 Numeric ran an unintended experiment. On the one hand we had 26 classrooms of learners in Cape Town, all of which were using Khan Academy. On the other hand, we had 18 classrooms of learners in Johannesburg, none of which had Khan Academy, but all of which had coaches who had undergone a rigorous recruitment and training process.

Every year an independent assessment committee administers baseline tests in January and endline tests in November, across all of our partner schools in all of the townships in which we work. It is created, administered, graded and moderated externally, with a view to providing an independent, objective read-out of each of our programs.

By 2014, many of Numeric's program management processes had improved, and our Cape Town classroom metrics improved commensurately. The gross shift in test scores increased from 7.5 per cent in 2013 to 10.9 per cent 2014. After controlling for any corresponding improvement in the results of non-Numeric learners, the net shift generated by the programs improved from 5.1 per cent to 5.9 per cent over the same period (a delta of 0.46

compared with 0.31 the previous year[3]). Attendance and persistence rates also improved. However, it was the Soweto results that were really striking. The gross shift in test scores was 14.8 per cent for the year, and the net shift – after controlling for non-participating learners – was 9.9 per cent (a delta of 0.77). This brought Numeric's companywide net shift to 7.8 per cent (delta 0.6), much closer to our target of 10 per cent than in the previous year.

Despite all the anxiety and stress that the lack of computer lab infrastructure in Soweto had caused us, we came away with one extremely valuable lesson: it is not the technology that drives the learning outcome, but the quality of the coach (or teacher) you place into the classroom. In 2015 we implemented the same recruitment and training procedures in Cape Town, and observed Numeric's net-shift and delta increase to 9.8% and 0.68 respectively.

While we continue to be a big fans of Khan Academy, and employ it extensively in our coach- training processes and many of our programs, we now place a much greater emphasis on the recruitment and training of coaches. We have become big believers in the importance of teacher recruitment and training as a means of rebuilding South African maths education.

To come back to the McKinsey report: their researchers showed that in the top performing school systems globally – Singapore, Finland and South Korea – these countries recruit 100 per cent of their teachers from the top third of the academic cohort. In the United States, where they face declining performance in global standardised testing, just 23 per cent of teachers come from the top third. While the report did not assess the South African schooling system, I imagine we are unlikely to be much better than the US.

To quote the Director of the National Institute of Education in Singapore: "It is a no-brainer that a nation would want to have a top-quality teaching force. To get there, you have to do two things. First, attract the best people to the profession. Second, once they're in, you give them the best training." In a world where the quality of human capital is becoming increasingly important, I think this is sage advice. After all, our teachers are the custodians of our country's human capital. Surely it makes sense to invest in our teacher recruitment and training processes? As Lee Iacocca once said: "In any rational society the best of us would be teachers, and the rest of us would settle for something else."

With these observations in mind, I would make the following policy proposals:

1. Develop a strong recruitment strategy for Bachelor of Education (B.Ed) and Post-Graduate Certificate in Education (PGCE) programs, perhaps spearheaded by the Department of Basic Education (DBE) in collaboration with our teacher training institutions. I would even go so far as to suggest contracting one of South Africa's top

3 Delta is a statistical measure of impact. It is derived by dividing the net shift in test scores by the standard deviation to ascertain by how many standard deviations the test score was shifted. As a general rule of thumb, 0.2 is considered small, 0.5 is considered medium-sized, and 0.8 is considered large.

marketing agencies to put together a marketing and media strategy to attract top talent into our teacher training programs.

2. In the case of mathematics, introduce board exams for final year education students. At present, there is no quality control for students graduating from B.Ed or PGCE programs, with the result that we are releasing teachers into the system who are not adequately prepared for the curriculum they need to teach.

3. Place a heavy emphasis on the recruitment, and appropriate remuneration, of quality lecturers in the teaching-training space. There should be no compromise on the quality of South Africa's teacher-trainers. These people should be well-qualified, well-equipped and well-supported in their work.

Had this been 2005, I would have suggested a fourth point, proposing the (a) an increase in teacher salaries and (b) the financing of scholarships for pre-service teachers. These have, however, by now been largely taken care of, and credit must be given to the DBE for accomplishing this. A fully-qualified first-year teacher in a permanent post typically earns a gross salary of R20 000 per month. While this is probably striking to most people (who would expect it to be much lower), it should further be noted that this equates to 1.17 times the South African median wage. By this metric, South African teachers are remunerated better than either their Singaporean (0.98 times) or Finnish (0.81 times) counterparts. Furthermore, with the introduction of the Funza Lushaka bursary program in 2008, which funds full tuition, accommodation and a living stipend for meritorious pre-service teachers, applicant numbers for teacher training programs have more than tripled. This means that universities can now be more selective about the quality of candidate they accept into their training programs.

In conclusion, I think South Africa is making meaningful progress in its teacher training programs, primarily because of the budgetary allocations made by treasury to teacher remuneration and teacher training programs. One should bear in mind that the impact of these investments will begin to be felt only in five to ten years' time as these teachers begin to filter into the system, but it is a worthwhile – and indeed essential – investment nonetheless. What we could lay a greater emphasis on now is the recruitment strategies employed by universities to bring quality school-leavers into their B.Ed programs, as well as the training processes we implement for these teachers.

One final word of caution. There has, perhaps, been an overemphasis in South Africa on quantity over quality in recent years. Panic over perceived (and real) shortages of teachers has led to rapid expansion of teacher training programs, but not always with a commensurate focus on quality. Between 2009 and 2012, the number of South Africans enrolled in teacher training programs increased from 35,000 to over 94,000. While the media frequently laments the shortage of maths teachers in schools, a far more dangerous scenario is an oversupply of under-qualified teachers. When this happens, it becomes difficult for newly graduated teachers to find jobs. This makes studying to become a teacher less attractive, which in turn makes it more difficult to recruit talent into the profession. In places like Singapore and South Korea, the departments of education carefully regulate the number

of positions available in teacher-training programs to ensure that there are always positions available for graduating teachers. South Africa should do the same.

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